



AUTHORS — AUGUST 1990

SAFETY OF NEXT GENERATION POWER REACTORS

REACTIVITY FEEDBACK COMPONENTS OF A HOMOGENEOUS U10Zr-FUELED 900-MW(thermal) LIQUID-METAL REACTOR

David Meneghetti (top) (PhD, physics, Illinois Institute of Technology, 1954) has been responsible for the physics analyses of the Experimental Breeder Reactor II (EBR-II) for ~20 years. His research and development interests are in fast reactor analyses. **Dwight A. Kucera** (PhD, applied mathematics, Northwestern University, 1977) has been a computer mathematician with EBR-II for 15 years. His interests include computer modeling and program development.

*David Meneghetti
Dwight A. Kucera*



FAILED FUEL SURVEILLANCE DURING IN-VESSEL FUEL STORAGE IN FAST BREEDER REACTORS

Siegfried Jacobi (Dipl.-Phys., solid-state physics, University of Berlin, Federal Republic of Germany, 1959) joined the Kernforschungszentrum Karlsruhe (KfK) in 1959 and has been involved in nuclear instrumentation of the first German research reactor FR2. His specialty is failed fuel detection for nuclear power plants. His current areas of interest include core surveillance and failed fuel behavior concerning safety and availability of liquid-metal reactors. He is also a lecturer of the School for Nuclear Technology managed by KfK.

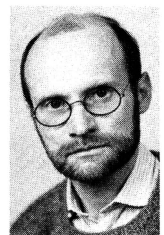
Siegfried Jacobi



TECHNOLOGY AND SAFETY ASPECTS OF THE GERMAN HIGH-TEMPERATURE GAS-COOLED REACTOR

Wolfgang Kröger (right) [Dr. Ing., nuclear engineering, University of Aachen, Federal Republic of Germany (FRG)] has been with Kernforschungsanlage (KFA) Jülich since 1974. He has been engaged in probabilistic safety assessments for high-temperature gas-cooled reactors and is currently evaluating safety requirements for advanced future reactors. He is acting director of the Institute for Nuclear Safety Research at KFA. He is also professor of safety at ETH Zurich and head of the Department of

*Wolfgang Kröger
Rudolf Schulten*



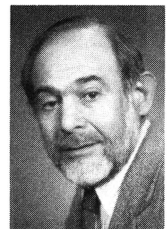
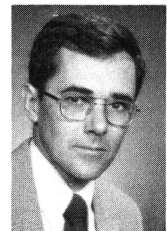
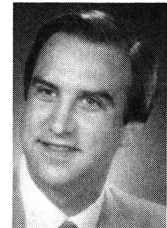
Nuclear Energy at the Swiss Federal Research Institute. **Rudolf Schulten** (right) (Dipl. Ing., physics and mathematics, University of Bonn, FRG, 1950; PhD, Max-Planck-Institut, 1953) is director of the Institute for Reactor Development at KFA. He is also a professor of reactor technology at the Technical University of Aachen.



ANALYSES OF UNSCRAMMED EVENTS POSTULATED FOR THE PRISM DESIGN

Gregory J. Van Tuyle (top right) (PhD, nuclear engineering, University of Michigan, 1978) is group leader for advanced reactor safety analysis in the Department of Nuclear Energy at Brookhaven National Laboratory (BNL). In addition to providing technical support to the U.S. Nuclear Regulatory Commission (NRC) in evaluating advanced reactor concepts and lead development of the RETRAN/MINET composite code, he participated in the U.S. Department of Energy team investigating causes of the Chernobyl accident. **Gregory C. Slovik** (top left) (MS, nuclear engineering, University of Arizona, 1980) is a research engineer in the Department of Nuclear Energy at BNL. He provided technical assistance to the NRC in assessing the TRAC and RELAP series of codes and was involved in the development of RAMONA-3B. His recent activities include evaluating the thermal-hydraulic response of the advanced liquid-metal reactor concepts and their margins to fuel damage. **Robert J. Kennett** (center right) (MS, computer science, State University of New York, Stony Brook, 1984) is a computer analyst in the Advanced Reactor Safety Analysis Division of the Department of Nuclear Energy at BNL. His areas of interest include numerical simulation, computer imaging, and scientific visualization. **Bing C. Chan** (bottom left) (MS, mechanical engineering, University of California, Berkeley, 1967; doctoral work, Stanford University, 1970) is a mechanical engineer in the advanced reactor safety analysis group at BNL. He provided technical support to the NRC in evaluating advanced reactor concepts, mainly in modeling and computational fluid mechanics, heat transfer, and applications. **Arnold L. Aronson** (bottom right) (BS, physics, Ohio State University, 1953) has worked in the area of reactor design and analysis since 1957. He is a member of the advanced reactor safety analysis group at BNL, and his interests include reactor physics, thermal hydraulics, and core transient analysis calculations.

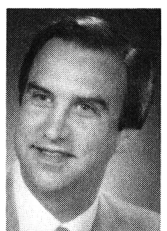
*Gregory J. Van Tuyle
Gregory C. Slovik
Robert J. Kennett
Bing C. Chan
Arnold L. Aronson*



EXAMINING THE INHERENT SAFETY OF PRISM, SAFR, AND THE MHTGR

Gregory J. Van Tuyle (top) (PhD, nuclear engineering, University of Michigan, 1978) is group leader for advanced reactor safety analysis in the Department of Nuclear Energy at Brookhaven National Laboratory (BNL). In addition to providing technical support to the U.S. Nuclear Regulatory Commission (NRC) in evaluating advanced reactor concepts and lead development of the RETRAN/MINET composite code, he participated in the U.S. Department of Energy team investigating causes of the Chernobyl accident. **Peter Kroeger** (bottom) (PhD, fluid

*Gregory J. Van Tuyle
Peter Kroeger
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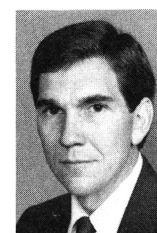
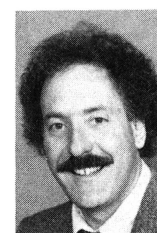
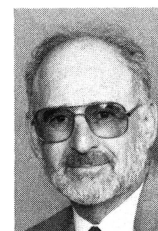
thermal and aerospace sciences, Case Western Reserve University, 1971) joined BNL in 1974 and has been employed in the simulation of nuclear reactor accidents. After 5 years in light water reactor blowdown analysis, he has concentrated on all aspects of high-temperature gas-cooled reactor safety analysis for the past 10 years. **Gregory C. Slovik** (top right) (MS, nuclear engineering, University of Arizona, 1980) is a research engineer in the Department of Nuclear Energy at BNL. He provided technical assistance to the NRC in assessing the TRAC and RELAP series of codes and was involved in the development of RAMONA-3B. His recent activities include evaluating the thermal-hydraulic response of advanced liquid-metal reactor concepts and their margins to fuel damage. **Bing C. Chan** (top left) (MS, mechanical engineering, University of California, Berkeley, 1967; doctoral work, Stanford University, 1970) is a mechanical engineer in the advanced reactor safety analysis group at BNL. He provided technical support to the NRC in evaluating advanced reactor concepts, mainly in modeling and computational fluid mechanics, heat transfer, and applications. **Robert J. Kennett** (bottom right) (MS, computer science, State University of New York, Stony Brook, 1984) is a computer analyst in the Advanced Reactor Safety Division of the Department of Nuclear Energy at BNL. His areas of interest include numerical simulation, computer imaging, and scientific visualization. **Arnold L. Aronson** (bottom left) (BS, physics, Ohio State University, 1953) has worked in reactor design and analysis since 1957. He is a member of the advanced reactor safety analysis group at BNL and his interests include reactor physics, thermal hydraulics, and core transient analysis calculations.



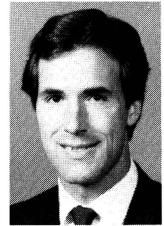
SAFETY AND LICENSING OF SAFR—AN ADVANCED LIQUID-METAL REACTOR

Robert T. Lancet (top right) [MS, mechanical engineering, University of Cincinnati; ME, University of California, Los Angeles (UCLA)] is director of nuclear safety and licensing for Atomic International, Rocketdyne Division, Rockwell International (RI). He was responsible for the Sodium Advanced Fast Reactor (SAFR) safety and licensing activities, including preparation of the PSID and discussion with the U.S. Nuclear Regulatory Commission (NRC) leading to a draft safety evaluation report. His previous responsibilities were safety research and development (R&D), including development and/or experiments on sodium fires, sodium-water reactions, core disruptions, and response to core disruptive accident loads. **Robert Z. Litwin** (top left) (BS, mechanical engineering, California State University, 1972) has had 17 years of experience in liquid-metal reactor (LMR) technology with RI. He was responsible for the design of the shutdown heat removal system for the SAFR and LPSB programs. He previously worked on the modular steam generator test and Clinch River Breeder Reactor programs. **Ravneesh C. Amar** (bottom right) (PhD, mechanical engineering, UCLA, 1974) has 14 years of experience in the nuclear industry, the last 11 years in LMR research. He has been a project engineer for decay heat removal and core debris accommodation R&D programs. He also participated in the safety analysis for the SAFR plant. **Robert D. Rogers** (bottom left) (MS, nuclear engineering, Texas A&M University) began his career with the U.S. Navy Nuclear Power Program and has 17 years of experience in nuclear analysis, reactor operations, and nuclear systems management. He has been responsible for coordinating NRC licensing requirements for SAFR and for preparing the SAFR PSID and presenting it to the NRC. He spent 4 years as manager

*Robert T. Lancet
Robert Z. Litwin
Ravneesh C. Amar
Robert D. Rogers
Alan V. von Arx*



of reactor operations and assistant director of the Texas A&M Nuclear Science Center, where his responsibilities included reactor operations and administration. **Alan V. von Arx** (right) (MS, mechanical engineering, California State University, 1982) has 15 years of experience in engineering with RI, with 12 years in LMR thermal-hydraulic analyses, including decay heat removal systems, reactor core thermal hydraulics, and sodium-to-water steam generators. He has developed detailed computer models and numerical techniques to solve a variety of complex problems.



PROBABILISTIC EVALUATION OF SUCCESSFUL INHERENT SHUTDOWN IN UNPROTECTED ACCIDENTS IN INNOVATIVE LIQUID-METAL REACTORS

Charles J. Mueller (top) (PhD, nuclear engineering, Northwestern University, 1969; MBA, University of Chicago, 1988) has been the associate director of the Computing and Telecommunications Division of Argonne National Laboratory (ANL) since 1988. He was previously manager of probabilistic risk assessment in the Reactor Safety and Analysis Division. He has also served as a consultant to the Advisory Committee on Reactor Safeguards in the areas of risk analysis and nuclear safety for both commercial and advanced reactors. **David C. Wade** (PhD, nuclear engineering, Massachusetts Institute of Technology) is associate director of the Engineering Physics Division of ANL. He has been associated with the innovative liquid-metal reactor core design at ANL since its inception in 1984. His experience is in methods development, critical experiment analysis, and core design for fast and thermal reactors.

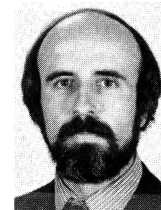
*Charles J. Mueller
David C. Wade*



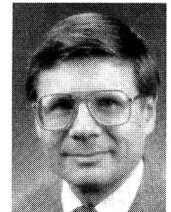
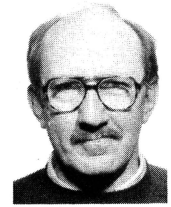
RISK CHARACTERIZATION OF SAFETY RESEARCH AREAS FOR INTEGRAL FAST REACTOR PROGRAM PLANNING

Charles J. Mueller (top right) (PhD, nuclear engineering, Northwestern University, 1969; MBA, University of Chicago, 1988) has been the associate director of the Computing and Telecommunications Division of Argonne National Laboratory (ANL) since 1988. He was previously manager of probabilistic risk assessment (PRA) in the Reactor Safety and Analysis Division. He has also served as a consultant to the Advisory Committee on Reactor Safeguards in the areas of risk analysis and nuclear safety for both commercial and advanced reactors. **James E. Cahalan** (top left) (PhD, nuclear engineering, Purdue University, 1976) is manager of the Accident Analysis Section of the Reactor Analysis and Safety Division of ANL. His responsibilities include development and applications of methods for reactor safety analysis. **David J. Hill** (center right) (PhD, mathematical physics, Imperial College of Science and Technology, London University, England, 1974) is manager of Experimental Breeder Reactor II (EBR-II) safety analysis in the Reactor Analysis and Safety Division of ANL. He is currently leading the EBR-II PRA. **John M. Kramer** (bottom left) (PhD, engineering mechanics, University of Wisconsin, 1969) is manager of the Fuel Behavior Section of the Reactor Analysis and Safety Division at ANL. His most recent work involves the modeling of the response of metallic fast reactor fuels to accident transients. **John F. Marchaterre** (bottom right) (BS, 1954; MS, 1956; and Eng., 1960, chemical engineering, Michigan Technological University; MBA,

*Charles J. Mueller
James E. Cahalan
David J. Hill
John M. Kramer
John F. Marchaterre
Dean R. Pedersen
Roger W. Tilbrook
T. Y. C. Wei
Arthur E. Wright*



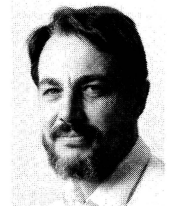
University of Chicago, 1980) is director of the Reactor Analysis and Safety Division of ANL. He has been active in fast reactor safety research for many years. **Dean R. Pedersen** (top) (PhD, mechanical engineering, University of Minnesota, 1972) is manager of the liquid-metal reactor (LMR) program in the Reactor Analysis and Safety Division of ANL. His experience is in experimental thermal hydraulics, in- and out-of-pile fast reactor experiments, and LMR safety. **Roger W. Tilbrook** (center) (BSc, mechanical engineering, Queen Mary College, University of London, England, 1962) is a nuclear engineer in the Reactor Analysis and Safety Division of ANL. Before joining ANL, he was manager of safety analysis at Westinghouse Advanced Energy Systems Division. His current interests include safety evaluations of new reactor plant systems and the safety of LMR fuels. **T. Y. C. Wei** (no photograph available) (PhD, nuclear engineering, Massachusetts Institute of Technology (MIT)) works in the Reactor Analysis and Safety Division of ANL, where his research work includes plant transient analysis, expert system control, and severe accident phenomena for both fast and thermal reactor systems. **Arthur E. Wright** (bottom) (PhD, nuclear engineering, MIT) is manager of the Fuels Experiments Section of the Reactor Analysis and Safety Division of ANL. He has been involved in in-reactor safety experimentation and experiment analysis since joining ANL in 1972.



PASSIVE SAFETY CHARACTERISTICS OF FUEL FOR A MODULAR HIGH-TEMPERATURE REACTOR AND FUEL PERFORMANCE MODELING UNDER ACCIDENT CONDITIONS

Karl Verfondern (top) [PhD, physics, University of Bonn, Federal Republic of Germany (FRG), 1983] is employed by Kernforschungsanlage (KFA) Jülich at the Institute for Nuclear Safety Research, where he is developing computer models to describe fission product release behavior in high-temperature gas-cooled reactor (HTGR) accidents and their use in risk assessment. **Werner Schenk** (center) (Dr. Ing., nuclear engineering, University of Aachen, FRG, 1978) has been employed at the KFA Jülich Hot Cell Laboratories since 1964. He is currently responsible for accident simulation testing with HTGR fuel and postirradiation annealing examination, particularly at very high temperatures. **Heinz Nabielek** (bottom) (PhD, physics, University of Vienna, Austria) is at KFA Jülich, where he is developing spherical fuel elements for pebble-bed reactors and performing experiments with the Arbeitsgemeinschaft Versuchsreaktor.

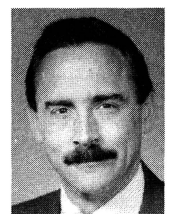
*Karl Verfondern
Werner Schenk
Heinz Nabielek*



MODULAR HIGH-TEMPERATURE GAS-COOLED REACTOR SHORT-TERM THERMAL RESPONSE TO FLOW AND REACTIVITY TRANSIENTS

John Cleveland (MS, physics, Virginia Polytechnic Institute and State University, 1972) has been a development staff member at the Oak Ridge National Laboratory since 1974. He has performed design, performance, and safety analyses for a variety of reactor types, including commercial and space reactors. He is currently responsible for gas-cooled thermal hydraulics and safety evaluations of modular high-temperature gas-cooled reactors, and for related cooperative programs with Kernforschungsanlage Jülich.

John Cleveland



LIQUID-METAL REACTOR APPLICATIONS OF THE CONTAIN CODE

Daniel E. Carroll (no photograph available) (PhD, physics, University of Wyoming, 1975) is a computational physicist with Sandia National Laboratories (SNL). He has been involved in code development for CONTAIN for 4 years. His current projects are in the field of satellite data analysis. **Kenneth D. Bergeron** (no photograph available) (PhD, physics, Brandeis University) is a supervisor for the New Production Reactor Engineering Development Division at SNL. He is coordinating efforts at SNL to apply safety technology developed for commercial reactors to the U.S. Department of Energy's New Production Reactor. **Werner Scholtyssek** (no photograph available) (Dipl. Phys., Wurzburg, Federal Republic of Germany, 1969) has worked at Kernforschungszentrum Karlsruhe since 1969. He has investigated experimental and analytical reactor physics. His current interests are accident sequences and source term studies in containments. **Greg D. Valdez** (no photograph available) is a computational engineer at SNL. His current interests are in particle beam fusion engineering. **Richard Gido** (no photograph available) (MS, mechanical engineering, University of New Mexico) is an analyst with 16 years of experience with nuclear power plant containment thermodynamics. He recently joined the CONTAIN project at SNL.

*Daniel E. Carroll
Kenneth D. Bergeron
Werner Scholtyssek
Greg D. Valdez
Richard Gido*